

Neotropical Monogenoidea 37. Redescription of *Gyrodactylus superbus* (Szidat, 1973) comb. n. and description of two new species of *Gyrodactylus* (Gyrodactylidea: Gyrodactylidae) from *Corydoras paleatus* and *C. ehrhardti* (Teleostei: Siluriformes: Callichthyidae) of Southern Brazil

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Abstract. Two new species of *Gyrodactylus* (Gyrodactylidae) are described from *Corydoras paleatus* (Jenyns) and *Corydoras ehrhardti* Steindachner (Callichthyidae) of Rio Piraquara, Municipality of Piraquara, near Curitiba, Paraná, Brazil: *Gyrodactylus anisopharynx* sp. n. and *Gyrodactylus samirae* sp. n. These species are unique among the known Neotropical species of *Gyrodactylus* by the combination of several characters. *Gyrodactylus anisopharynx* is characterised by having hooks with point evenly curved, toe moderately pointed, round convex heel, straight sloping shelf, superficial bar with anterolateral projections and male copulatory organ armed with two rows of spinelets. Two variants of *G. anisopharynx*, of distinct pharynx size, are recognised: forma "large-pharynx" and forma "small-pharynx". *Gyrodactylus samirae* is characterised by having hook with straight shaft, short slightly recurved point, truncate toe, trapezoidal heel, shelf slightly concave, orthogonal to shaft; anchors with relatively short superficial root; superficial bar with extremities lightly expanded; and male copulatory organ armed with two rows of spinelets. *Paragyrodactyloides superbus* (Szidat, 1973) is redescribed and transferred to *Gyrodactylus* based on examination of type and new specimens. Features previously considered as diagnostic for the genus are misinterpretations or primitive characters for *Gyrodactylus* spp.

According to Boeger and Popazoglo (1995), 25 species of Gyrodactylidae are known from fishes in the Neotropical Region, of which 11 are species of *Gyrodactylus*. Only *Paragyrodactyloides superbus* (Szidat, 1973), the first species described from this biogeographical realm, is reported from a species of *Corydoras* (Siluriformes, Callichthyidae), *Corydoras paleatus* (Jenyns, 1842).

During a study of the monogenoidean parasites of *C. paleatus* and *C. ehrhardti* Steindachner, 1910 in Southern Brazil, *P. superbus* and two new species of *Gyrodactylus* were collected from rivers of the Metropolitan Area of Curitiba, Paraná. In this paper, these two new species are described and *P. superbus* is redescribed and transferred to *Gyrodactylus*.

MATERIALS AND METHODS

Specimens of *Corydoras paleatus* (n = 18) and *C. ehrhardti* (n = 16) were captured from Rio Piraquara, Municipality of Piraquara, and Rio Pequeno, Municipality of São José dos Pinhais (both), Paraná, Brazil, from March of 1993 to December of 1994. Method of parasite collection and preparation are those described by Kritsky et al. (1995).

Additionally, the haptor of some specimens was separated from the body with the aid of a probe; the trunk was stained with Gomori's trichrome and the haptor mounted in Hoyer's medium. This procedure allowed study of soft and hard structures of a same individual. Measurements were made with the aid of an ocular micrometer; angles were measured with the aid of a protractor on drawings. Measurements are presented in micrometres; the average is followed by the range and number of measured structures (n) in parentheses. Anchors were measured according to method of Kritsky et al. (1995). Drawings were made with the aid of a drawing tube attached to a Zeiss Laboval 4 microscope. Types and vouchers were deposited in the following institutions, as indicated in respective descriptions: Coleção Helmintológica do Instituto Oswaldo Cruz, Rio de Janeiro, Brasil, (CHIOC), United States National Parasitological Collection, Beltsville, USA (USNPC); Harold W. Manter Laboratory, Lincoln, USA (HWML); Laboratoire de Biologie Parasitaire, Protistologie, Helminthologie, Muséum National d'Histoire Naturelle, Paris, France (MNHN); and Institute of Parasitology, Academy of Sciences of the Czech Republic, České Budějovice, Czech Republic (IPCR). A syntype of *P. superbus* (No. 28.003-I, Museo de Ciencias Naturales "Bernardino Rivadavia", Buenos Aires, Argentina) was studied for comparison purposes.

SURVEY OF SPECIES

POLYONCHOINEA Bychowsky, 1937

GYRODACTYLIDEA Bychowsky, 1937

Gyrodactylidae Van Beneden et Hesse, 1863

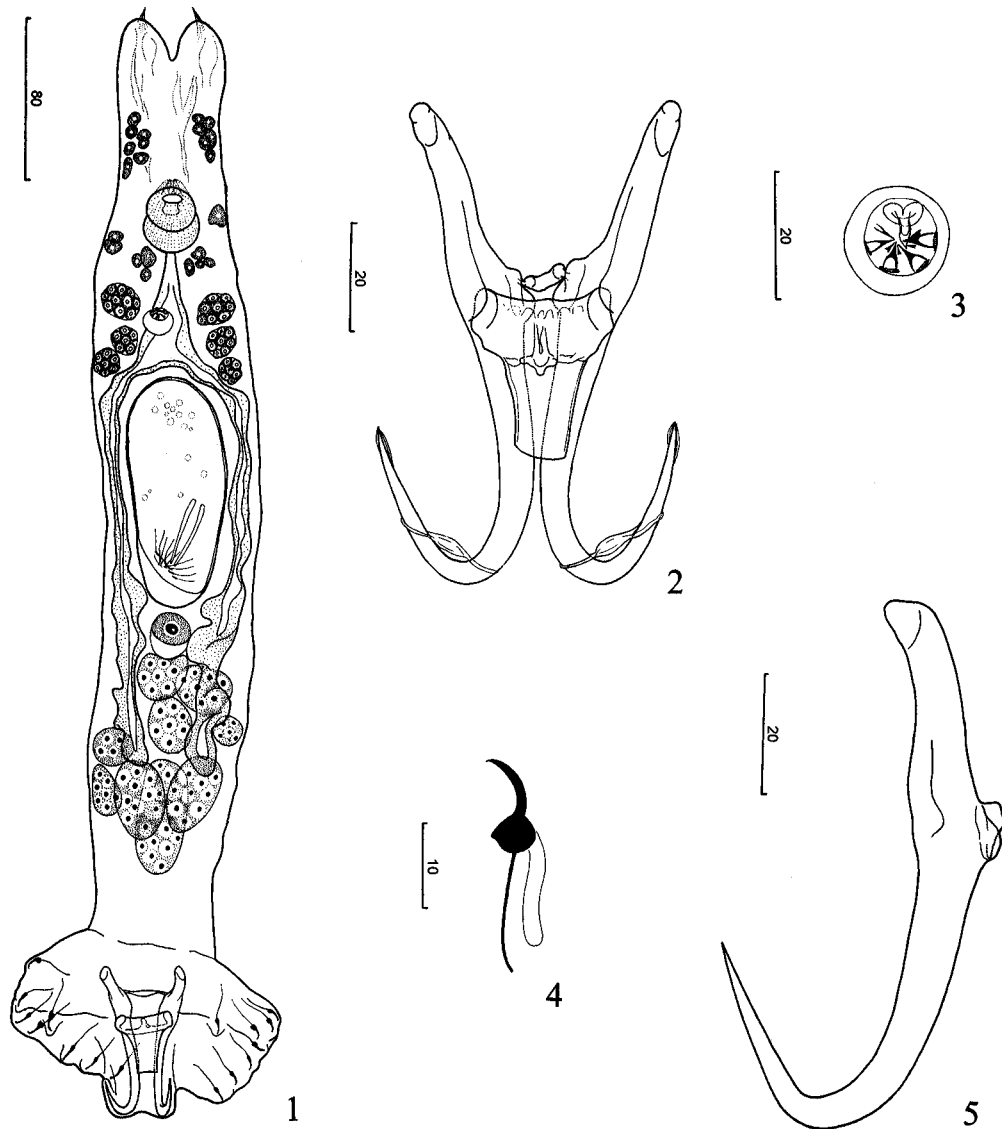
Gyrodactylus superbis (Szidat, 1973) comb. n.

Figs. 1-5

Synonyms: *Paragyrodactylus superbis* Szidat, 1973; *Paragyrodactyloides superbis* (Szidat, 1973) Nuñez, 1975.

Redescription. Body elongate, 494 (424-606; n = 8) long, 99 (77-129; n = 9) wide. Cephalic glands, head organs conspicuous. Cephalic glands distributed anterior, lateral, posterior to pharynx. Proximal pharyngeal bulb 70 (61-108, n = 9) wide; distal pharyngeal bulb 62 (51-94; n = 9) wide, with digitiform

projections. Three groups of esophageal glands located lateral to esophagus. Testis not observed. Male copulatory organ 16 (13-19; n = 6) wide, armed with 1 spine and 2 rows of spinelets; external row with 4 large spinelets with wide, truncate base; internal row with 5 small spinelets. Germarium oval, 27 (16-37; n = 8) long, 21 (12-32; n = 8) wide. Uterus with up to 2 (n = 19) generations of embryos. Large follicles, posterior to germarium (vitellaria?). Haptor 102 (87-121; n = 9) long, 97 (69-123; n = 9) wide. Anchor 87 (74-94; n = 14) long, with straight shaft, 53 (48-57; n = 14) long; straight point 34 (31-38; n = 14) long; deep root moderately developed; superficial root slender, elongate; base 44 (38-49; n = 14) long; angle shaft point 61° (53°-68°; n = 14). Superficial bar 27 (25-31; n = 9) long, 9 (7-11; n = 10) wide; shield trapezoidal, 20



Figs. 1-5. *Gyrodactylus superbis* (Szidat, 1973). **Fig. 1.** Voucher (ventral). **Fig. 2.** Anchor-bar complex. **Fig. 3.** Male copulatory organ. **Fig. 4.** Hook. **Fig. 5.** Anchor. Scale bars in µm.

(19-22; n = 4) long. Deep bar flexible. Hook with point evenly curved, long shaft, depressed toe, convex heel, shelf lightly concave; shank 17 (14-26; n = 14) long; distal portion of hook 12 (11-13; n = 16) long; FH loop 4/5 of shank length.

Type host: *Corydoras paleatus* (Jenyns, 1842).

Other host: *Corydoras ehrhardti* Steindachner, 1910 (this study).

Site of infestation: body surface.

Type locality: The original host was collected from an aquarium at the Museo de Ciencias Naturales "Bernardino Rivadavia", Buenos Aires, Argentina.

Other localities: Rio Piraquara, Piraquara, Paraná, Brazil, 02/III/93; 22/IV/94 and 09/V/94; Rio Pequeno, São José dos Pinhais, Paraná, Brazil; 02/III/93.

Specimens studied: 1 syntype, MBR N.º 28003-I; 3 vouchers, FIOC 34224, 34225; 3 vouchers, MNHN 822 HF; 3 vouchers, USNM 89392-89394; 7 vouchers, HWML 15198, 15235, 15236; 1 voucher, IPCR M-356.

Remarks. Szidat (1973) proposed *Paragyrodactylus* for the new species *P. superbus*, from *C. paleatus* collected in an aquarium of the Museo de Ciencias Naturales "Bernardino Rivadavia", Buenos Aires. Nuñez (1975) recognised the homonym of the new genus with *Paragyrodactylus* Gvozdev et Martechov, 1953 and proposed the name *Paragyrodactyloides* for the genus of Szidat (1973).

The main diagnostic characteristic of *Paragyrodactyloides*, as defined by Szidat (1973), is the presence of a "Gebärmuskel" (muscle-of-birth), which would have the function of pushing the embryo from the uterus during birth. This function, according to Szidat (1973), would be provided, in species of *Gyrodactylus*, by the musculature of the uterus. Other diagnostic characters of the genus, are: 1) "pointed" structures located in the cephalic lobes; 2) single muscular pharynx, lacking a glandular area, deprived of digitiform projections and armed with three sickle-shaped "teeth"; 3) four glands on the surface of a contractile bladder which opens in the esophagus (two groups, one on each side of the esophagus) (Szidat 1973). In the original description of *P. superbus*, the shield is not mentioned nor illustrated; the only measurement provided is the length of the embryo (0.05-0.06 mm).

A "muscle-of-birth" was not observed in any of the specimens presently studied. Apparently, the author interpreted structures of the embryo erroneously. In two of Szidat's (1973) figures (figs. 1, 22), the structures indicated as "muscle-of-birth" are, likely, the pharynx and a mass of cells of a developing embryo. "Contractile bladders" have also not been identified in the specimens studied and probably represent the distal portion of the excretory bladders, which lies near the cephalic glands (see figs. 23 A, B, C of Szidat 1973).

The pharynx, unlike the description of Szidat (1973), is composed of two bulbs: a muscular distal bulb, with digitiform projections and a proximal, glandular bulb.

The pharyngeal "teeth", mentioned by Szidat (1973), were not observed. The "pointed" structure on the cephalic lobes are the spike sensilla, found in *Gyrodactylidae* and related families (see Boeger and Kritsky 1993, 1997). Esophageal glands were verified, but their morphology and number are different from the original description. They are formed by three groups of cells lateral to the esophagus.

Therefore, the main diagnostic characters of *Paragyrodactyloides*, provided by Szidat (1973), either are erroneous interpretations or do not represent autapomorphies of the genus. The monotypic *Paragyrodactyloides* is, thus, unjustified. *Paragyrodactyloides superbus* is transferred to *Gyrodactylus*.

***Gyrodactylus anisopharynx* sp. n.** Figs. 6-13

Description. Body fusiform, 384 (290-435; n = 15) long, 92 (74-120; n = 15) wide. Cephalic glands and head organs conspicuous. Cephalic glands anterolateral, posterolateral to pharynx. Proximal pharyngeal bulb glandular; distal pharyngeal bulb muscular; digitiform projections of distal pharyngeal bulb indistinct. Pharynx polymorphic related to size: proximal pharyngeal bulb 55 (48-64; n = 13) wide, distal pharyngeal bulb 51 (37-59; n = 13) wide (forma "large-pharynx"); proximal pharyngeal bulb 31 (25-35; n = 3) wide, distal pharyngeal bulb 28 (21-33; n = 3) wide (forma "small-pharynx"). Testis dorsal to germarium, ovate, 25 (20-30; n = 2) long, 19 (15-23; n = 2) wide. Male copulatory organ 16 (13-20; n = 7) wide, armed with 1 spine, 2 rows of spinelets; external row and with 6 to 7 large spinelets, 4-5 spinelets with wide, truncated, base; internal row with 3-4 small spinelets. Germarium ovate, 25 (16-34; n = 7) long, 20 (13-23; n = 6) wide. Uterus with up to 2 (n = 34) generations of embryos. Large follicles, posterior to germarium (vitellaria?). Haptor 81 (62-102; n = 14) long, 76 (58-93; n = 13) wide. Anchor 65 (46-73; n = 29) long; shaft 43 (31-48; n = 29) long; straight point 28 (23-31; n = 29) long; deep root moderately developed; superficial root robust; base 29 (20-33; n = 29) long; angle of shaft/point 57° (46°-63°; n = 29). Superficial bar 25 (21-41; n = 19) long, 8 (5-13; n = 19) wide, with 2 small anterolateral projections; shield trapezoidal, 14-15 (n = 2) long. Deep bar relatively robust, flexible. Hook with shaft, point evenly curved, toe moderately pointed, round convex heel, straight sloping shelf; shank 15 (14-17; n = 42) long; hooklet 9 (7-11; n = 43) long; FH loop 2/3 shank length.

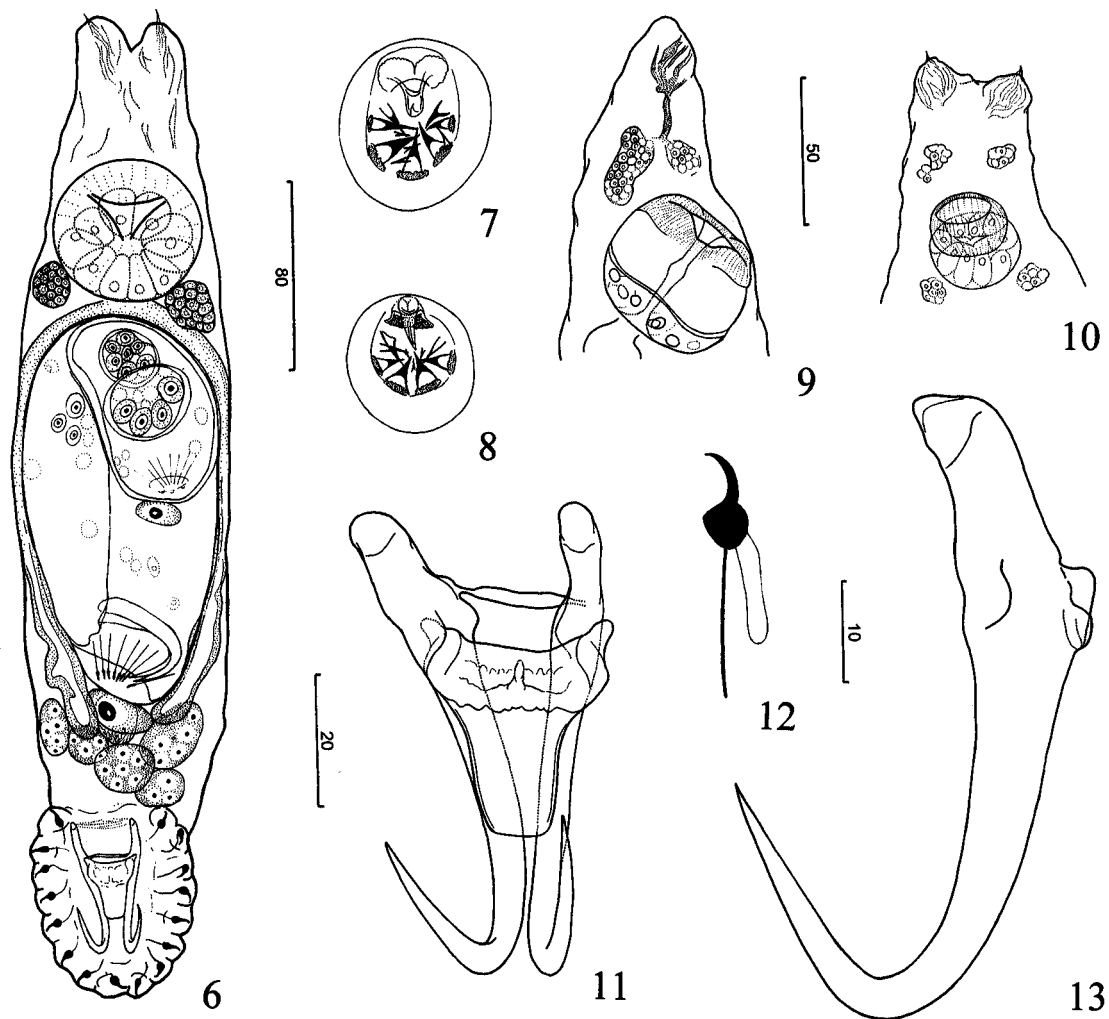
Type host: *Corydoras paleatus* (Jenyns, 1842).

Other host: *Corydoras ehrhardti* Steindachner, 1910.

Site of infestation: body surface.

Type locality: Rio Piraquara, Piraquara, Paraná, Brazil; 03/II/93, 22/IV/94 and 05/IX/94.

Other locality: Rio Pequeno, São José dos Pinhais, Paraná, Brazil; 03/II/93.



Figs. 6-13. *Gyrodactylus anisopharynx* sp. n. **Fig. 6.** Holotype (ventral). **Figs. 7, 8.** Male copulatory organ. **Fig. 9.** Cephalic region of the forma "large-pharynx". **Fig. 10.** Cephalic region of the forma "small-pharynx". **Fig. 11.** Anchor-bar complex. **Fig. 12.** Hook. **Fig. 13.** Anchor. The illustrations are presented in the following scales: Fig. 6 – 80µm scale bar; Figs. 7, 8, 12, 13 – 10µm scale bar; Figs. 9, 10 – 50µm scale bar; Fig. 11 – 20µm scale bar.

Specimens studied: holotype, FIOC 34215; 19 paratypes, FIOC 34216-34223; 8 paratypes, USNPC 89395-89396; 7 paratypes, HWML 15197-15198; 7 paratypes, MNHN 823HF; 2 paratypes, IPCR M-358.

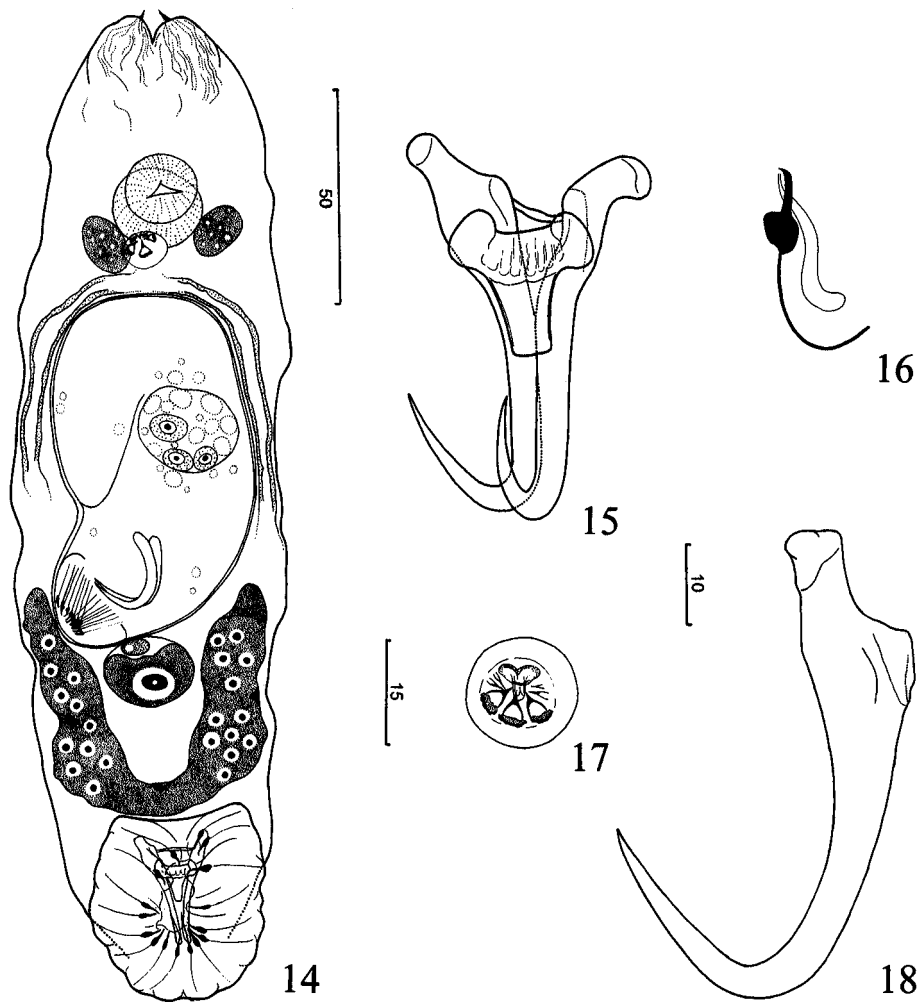
Etymology: The specific epithet is from Greek and refers to the variability of the pharynx in this species (aniso = unequal; pharyng/o = pharynx).

Remarks. Two variants of *G. anisopharynx*, of distinct pharynx size, are recognised: *G. anisopharynx* forma "large-pharynx" (Fig. 9) and forma "small-pharynx" (Fig. 10). No other morphologic characteristic is significantly different between these two variants and, therefore, the two groups are considered conspecific.

Several studies describe the variation of size of hard structures of the haptor of *Gyrodactylus* spp. in relation to environmental factors (Malmberg 1970, Appleby 1996, Shinn et al. 1995) but no reference exists on the morphologic variation of the pharynx. Seemingly, there

is no relationship between the size of the pharynx of *G. anisopharynx* and the host species and environmental factors. Specimens of both morphologic groups were concurrently collected from all collection places, dates, and host species.

Gyrodactylus anisopharynx and *G. superbis* are morphologically similar in the following characteristics: 1) male copulatory organ with two rows of spinelets – external row comprising large spinelets and internal row with small spinelets; 2) hooks with shaft and point evenly curved, convex heel, and straight shelf. However, the new species can be easily differentiated from *G. superbis* by: 1) the hook with comparatively shorter shaft; 2) the superficial root of the anchor comparatively shorter; and 3) the presence of conspicuous anterolateral projections on the superficial bar.



Figs. 14-18. *Gyrodactylus samirae* sp. n. **Fig. 14.** Holotype (ventral). **Fig. 15.** Anchor-bar complex. **Fig. 16.** Hook. **Fig. 17.** Male copulatory organ. **Fig. 18.** Anchor. The illustrations are presented in the following scales: Fig. 14 – 50µm scale bar; Figs. 15-17 – 15µm scale bar; Fig. 18 – 10µm scale bar.

***Gyrodactylus samirae* sp. n.**

Figs. 14-18

Description. Body fusiform, 216 (195-285; n = 9) long, 72 (61-87; n = 9) wide. Cephalic glands, head organs conspicuous. Cephalic glands posterolateral to pharynx. Proximal pharyngeal bulb 21 (20-23; n = 9) wide; distal pharyngeal bulb 18 (16-20; n = 9) in diameter; digitiform projections of distal pharynx not observed. Testis oval, 23 (n = 1) long, 13 (n = 1) wide. Male copulatory organ 12 (9-17; n = 9) wide, armed with 1 spine, three large spinelets of truncate wide bases and 4 to 6 small spinelets. Germarium oval, 22 (19-24; n = 4) long, 14 (9-18; n = 4) wide. Uterus with up to 2 (n = 24) embryos. Syncytial U-shaped mass posterior to germarium (vitellaria?). Haptor 43 (35-52; n = 9) long, 51 (46-59; n = 9) wide. Anchor 42 (39-44; n = 18) long;

shaft relatively straight, 30 (28-32; n = 18) long; point straight, 19 (17-20; n = 18) long; deep root poorly developed; superficial root relatively short; base 18 (14-20; n = 18) wide; angle shaft/point 58° (46°-71°; n = 17). Superficial bar with extremities lightly expanded 14 (10-20; n = 21) long, 4 (3-6; n = 16) wide; shield trapezoidal 6 (5-6; n = 7) long. Deep bar flexible. Hook with straight shaft, short slightly recurved point, truncate toe, trapezoidal heel, shelf slightly concave, orthogonal to shaft; shank 13-14 (n = 19) long; hooklet 6 (5-7; n = 21) long; FH loop 2/3 of shank length.

Type host: *Corydoras ehrhardti* Steindachner, 1910.

Other host: *Corydoras paleatus* (Jenyns, 1842).

Site of infestation: body surface.

Type locality: Rio Piraquara, Piraquara, Paraná, Brazil; 22/IV/94 and 09/V/94.

O t h e r l o c a l i t y : Rio Pequeno, São José dos Pinhais, Paraná, Brazil; 02/III/93.

S p e c i m e n s s t u d i e d : holotype, FIOC 34226 a; 10 paratypes, FIOC 34226 b, 34227-34229; 4 paratypes, USNPC 89397-89399; 3 paratypes, HWML 15199; 3 paratypes, MNHN 824HF; 2 paratypes, IPCR M-359.

E t y m o l o g y : The specific name is a homage to Prof. Samira Chahad (UFPR, Brazil).

Remarks. *Gyrodactylus samirae* can be differentiated from other species of the genus in the following manner: 1) hook with wide, somewhat rectangular base, straight thin shaft, and short point; and 2) male copulatory organ with three large spinelets each with wide, truncate base.

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